TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, IN SITU CHARACTERIZATION AND MONITORING OF SOIL CONTAMINATED BY RADIONUCLIDES

Identification No.: RL-SS16
Date: September 2001

Program: Environmental Restoration
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit(s): All Soil Sites
PBS No.: RL-RC01 (RL-ER01), RC02 (RL-ER03), RL-CP01 (RL-ER02)
Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]
TSD Title: N/A
Waste Management Unit (if applicable): N/A
Facility: N/A

***Priority Rating*:**

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

_X_ 1. Critical to the success of the ACPC
____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success

The four major core projects of the Groundwater/Vadose Zone Integration Project (200 Area Remediation, Immobilized Low-Activity Waste Performance Assessment, Tank Farm Closure, and Tank Farm Vadose Zone) list this need as a high priority.

Need Title: Improved, In Situ Characterization and Monitoring of Soil Contaminated by Radionuclides

Need/Opportunity Category: Technology Need

Need Description: The extent of contamination in soil and burial ground sites is often poorly defined. A cost-effective technology that provides real-time, in situ measurement of radioactive contaminants (uranium, plutonium, cesium, cobalt, technetium-99, strontium-90, iodine, and selenium) in soils at depth is required to better define the contaminant plume boundaries prior to remediation and also to support long-term monitoring for performance validation of the completed remediation activity or to provide monitoring as part of Monitored Natural Attenuation.. Characterization of TRU is also needed for some 200 Area waste sites. In situ

monitoring is also needed to support long term monitoring associated with long-term stewardship of contaminated soils.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/13

Characterization and remediation of the 200 Area sites began in FY99 and is expected to continue through 2018. Soil Remediation is ongoing in the 100 and 300 Areas, and is expected to be completed before 200 Area remediation. Tank farm characterization is ongoing with planning for remedial action and closure having started. The first tank farm is scheduled to be closed by 2014.

***Problem Description*:** The approximate total volumes of soil requiring remediation at the Hanford Site (liquid waste disposal sites and burial grounds) are: 3.9 million cubic yards in the 100 Areas, approximately 10 million cubic yards in the 200 Areas, and 0.8 million cubic yards in the 300 Area. The 100 Area has over 340 contaminated soil sites that are expected to require remediation. Soil units include cribs, french drains, trenches, ponds, and retention basins that received radiologically and chemically contaminated liquid effluent from reactor and support operations. Cobalt and strontium-90 are the main radioactive contaminants of concern. The 300 Area has several soil sites that resulted from liquid disposal in ponds and trenches. Uranium is used as an indicator contaminant and soils with concentrations greater than 350 picocuries/gram in the top 15 feet are removed. The 200 Area contains approximately 1000 different soil and burial ground sites. Soil waste sites are predominantly the result of liquid discharges to cribs, ponds and ditches. The 200 Area remediation includes a combination of removal and leave in-place with in situ treatment and/or surface barrier placement strategies. Monitored natural attenuation is also considered a potential alternative. The target/indicator contaminants will be developed for the 200 Area as part of the characterization activities. However, plutonium, uranium, cesium, cobalt, technetium and strontium are likely to be the key indicator contaminants for many of the contaminated sites. Of primary importance is the need for in situ monitoring of the more mobile contaminants including technetium, strontium and uranium. The 200 Area will be performing significant characterization efforts at soil waste sites through FY08

Benefit to the Project Baseline of Filling Need: In situ technologies may provide cost and schedule savings over current baseline methods involving soil boring, labor intensive sampling, and laboratory analysis.

***Functional Performance Requirements*:** The cost-effective technology needs to provide real-time, in situ measurement of radioactive contaminants with field deployable instruments. Data must be easily downloaded into computer systems for analysis and retrieval. Detection limits down to required remediation levels or levels at which remediation alternative decisions can be made would be preferable, but higher detection level instruments that could be deployed economically at depth are also of interest. If possible, the technique should support the eventual replacement of the requirement for sample collection and analysis. Detection of total uranium at 50 pCi/g is needed in the 300 Area to

meet a 350 pCi/g remediation goal, but a lower detection limit may be required in the future. The following remediation goals can be found in the Remedial Design Report/Remedial Action Work Plan for the 100 Area (DOE/RL-96-17): U-233/234, 1.1 pCi/g; U-235, 1.0 pCi/g; U-238, 1.1 pCi/g; Pu-238, 37.4 pCi/g (1,123 pCi/g below 15 ft); Pu-239/240, 33.9 pCi/g (718,600 pCi/g below 15 ft); Cs-137, 6.2 pCi/g; Co-60, 1.4 pCi/g; Sr-90, 4.5 pCi/g; and Tc-99, 15 pCi/g. Analyses down to 200+ feet would be useful in some areas but deployment to depths between the surface and 50 ft would help supply missing information. The 200 Area sites do not currently have specific remediation goals, but contaminants of concern are the same as for the 100 Area with the addition of isotopes of iodine and selenium.

Work Breakdown Structure (WBS) No. : 1.4.03.1.1 (RL-RC01)
1.4.03.1.2 (RL-RC02)
1.4.03.3.1 (RL-CP01)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-026, PBS-MC-027, PBS-MC-028, M-15-00, M-16-00

***Justification For Need*:**

Technical: Highly accurate and easily operated instrumentation to measure the concentrations and movement of radioactive contaminants in situ will facilitate accurate remedial alternative decision making and soil remediation planning. In situ techniques will also reduce exposure to workers involved in characterization work.

Regulatory: Analyses completed as part of the effort to address this technology need will serve as the basis for reaching agreement with regulatory agencies on establishing performance objectives and criteria for remediation and closure of Hanford facilities. Also, information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions. In addition, capability to collect this information would also be useful to support selection and monitoring of remediation alternatives.

Environmental Safety and Health: In situ technologies would reduce the need for invasive sampling and the related potential for worker exposure.

Potential Life-Cycle Cost Savings of Need (in $000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is $10M. This estimate is based on an assumed savings of 1% of the total cost for the 100 Area of $900M.

Cultural/Stakeholder Concerns: There are concerns that inadequate waste site characterization will be used to support decisions to leave waste in place.

Other: None.

Current Baseline Technology: Borehole, cone penetrometer, cased wells and test pits, are used to gain access to the subsurface. A sensitive hyper-pure germanium gamma detector adapted for

bore hole use gathers radiation spectrums as it is lowered through a casing. Depending on the contaminant of concern, soil samples from the borehole may still require laboratory analysis.

Cost: Varied. Baseline characterization activities in the 200 Areas are estimated to be $70M.

Waste: Drill cuttings and laboratory wastes.

How Long It Will Take: Activities in the 200 Area are scheduled to continue through 2018.

End-User: Richland Environmental Restoration Project, River Protection Project Tank Farm Closure Program, River Protection Project Immobilized Waste Program

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